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THE DECAY AND PRESERVATION OF TIMBER FOR TELEGRAPH PURPOSES.*

By W. LANGDON.

There are two kinds of decay, viz., *dry* and *wet-rot*. The former is a slow mouldering action due to the presence of a species of fungus, by which all the tensile strength and cohesion of the wood is destroyed and reduced to a fine snuffy dust. To this we are fortunately so seldom subjected that it may be fairly disregarded. It is in *wet rot* that we find our great enemy. *Wet rot* is of two kinds,—*oxidation* and *disintegration*. The first is a species of slow combustion or "eremacausis." The albuminous and nitrogenous materials of the sap ferment under the influence of heat and moisture, and react on the cellulin and lignin which they decompose. Worms, insects, fungi, animalculæ, &c., enter the fibres of the wood and disintegrate its structure by their growth and multiplication. The oxygen of the air unites with the remains and slowly but surely rots it away.

The point at which telegraph poles decay is that at which the greatest strength is required, viz., the ground line, known as *the wind and water line*. The explanation of this is that the condition of a telegraph pole once planted speedily becomes analagous to that of its surrounding medium. Whilst that portion above ground, if unprotected by paint or some other oily preservative, acquires a degree of moisture almost equal to that held in the atmosphere surrounding it, the lowest portion—the butt end—will be found saturated with wet, the density of which becomes less and less as the ground line is reached. This moisture is due to absorption from the contiguous ground and percolation from the atmosphere. Besides "slow combustion," there is another process of disintegration of a mechanical nature, to which the destruction of our poles is mainly due. The tiny particles of moisture held in the outer pores of the wood first become heated by contact with the warmer atmosphere, then volatilise, and, finally bursting as under the delicate fibres by which they are bound, escape into the surrounding air. This action is again and again repeated until the structure is utterly destroyed.

The methods adopted for the preservation of timber are of two kinds,—the one applied *externally*, the other *internally*. The external applications are:—

1. *Seasoning*, which consists of stacking the poles in such a way that the air can freely circulate around them and favour the escape of the sap.
2. *Charring and Tarring*.

Charring consists in slightly roasting the surface of the pole, when it is dry, to a distance of 6 feet or more from the base. It expels the sap; destroys the external ligneous pores of the wood, coating it with a hard shell; checks absorption; and kills the germs of animal and vegetable life. It is done over a moderate fire. The portion charred and some 3 feet above is usually coated with tar while hot. The internal application of the best known preservative processes is—

1st. The introduction into the pores of the wood of some *salt*, which, uniting chemically with the albumen of the sap, is stated to convert it into an insoluble compound.

2nd. The introduction of some *oil*, which not only acts as an antiseptic, but renders the woody tissue waterproof.

Under the first head several processes have been tried, but the best known are Burnetising, Kyanising, and Boucherising.

Burnetising consists in impregnating the timber when dry with a solution of sulphate of zinc. The process does not appear to have been much employed of late years. *Kyanising* consists in impregnating the timber with a solution of corrosive sublimate (mercuric chloride). *Boucherising* consists in impregnating the timber with sulphate of copper, and is effected by applying a solution of this description to the butt-end of the pole under a gentle pressure. The lasting properties of this process appear to vary considerably.

We now come to the preservation of timber by oil, and under this head we have simply to deal with that system known as *creosoting*. Creosote is not only an antiseptic, but it destroys any vegetable germ which may exist in the timber. Its usual mode of application is by placing the poles within an air-tight cylinder, and exhausting the air from it. The creosote is then turned into the cylinder, and injected into the wood, under a pressure varying according to the contents of the cylinder. In creosote we no longer deal with an *absorbent of moisture*, but with something *directly opposed to it*. Let the timber be dry when the creosote is applied, and that under proper pressure; the result need not be questioned. But let the timber be wet, and it is probable that at no distant date the core will become rotten, for to this point will have been driven the moisture. It should not be forgotten that timber treated with creosote is not impervious to the sun's rays, which brings the oil to the surface. Some of it evaporates, whilst the rest trickles down the pole, forming a little mass around its base at the ground-line. It is desirable for this reason that such poles should occasionally be served with a coat of tar.

The merits of the processes are gathered from the following:—

(1). The life of an unprepared pole is seven years.

(2). That specially-selected foreign timber, Burnetised, has lasted with repairs from eighteen to twenty-four years.

(3). That Boucherised timber may be said to last ten to fourteen years.

(4). That creosoted poles planted twenty-five or twenty-six years since are still apparently in a state of perfect preservation.

It would thus appear that with those systems classed under the head of preservation by a salt by which *moisture is contracted*, we have a varying and uncertain extension of the life of timber; but in no case is this extension such as to compete with that secured by creosote, by which *moisture is*

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* Abstract of a paper read before the Society of Telegraph Engineers.

rejected. All preserved timber becomes what is technically termed "*short,*" that is, it easily breaks in two. When the whole of the wood is thoroughly impregnated with the process, its tensile strength becomes impaired.

RESEARCHES ON ELECTRICITY PRODUCED IN MECHANICAL ACTIONS.

The electricity developed in friction and pressure has at various times attracted attention; observers having studied chiefly the variations of electric tension with the nature and state of the bodies, the mode of mechanical action (including the time of action and the velocity of separation), the pressure of bodies rubbed or simply pressed, the form and dimensions of bodies, and the influence of temperature.

A French physicist, M. Joulin, has recently made a fresh investigation of the phenomena, bringing some new facts to light. His memoir, dealing with the subject in considerable detail, will be found in the *Annales de Chemie et de Physique* for May. A few words first of all on the historical part of the question (to which one of M. Joulin's chapters is devoted) may not be without interest.

As regards friction, the first observers thought the sign of the electricity developed depended simply on the nature of the bodies. Lists were given, in which each substance was positive with those before, and negative with those after it. Cavalls, Bergmann, and Faraday held that metals rubbed with most bodies are negative. Experiments by Canton and others proved that roughness has a negative tendency. Peclet, in 1834, studied the influence of different circumstances of movement, experimenting with a glass cylinder turned at different rates, with a rubber pressing against it. He considered that the tension increased during a short time, after which it remained constant; that the same quantity of electricity was produced each turn, whatever the rate; that pressure was without influence on the tension; and that friction of sliding and of rolling gave the same electric tension. He also studied the effect of size; with the same length of rubber, the breadth and thickness were without influence; with conducting rubber, the quantity of electricity in the cylinder diminished when the curvature of the edge of contact increased.

As regards pressure, it is chiefly M. Becquerel who studied the laws of development of electricity by it. He found—(1) That, with the same velocity of separation of pressed bodies, the tension of the electricity was proportional to the pressure; (2) that, with the same pressure, the electric tension increased with the velocity of separation. As to temperature, Coulomb (in 1785), rubbing heated strips of paper on woollen or silk stuffs, found them, successively, negative without electricity, and positive as the paper cooled. Bergmann, Dessaignes, Peclet, and others have observed that heat gives to bodies a negative tendency. M. Becquerel remarks that a slight difference of temperature between similar pressed portions of the same body suffices to cause liberation of electricity by pressure.

All these phenomena have been referred to three kinds of causes—the *molecular vibrations* produced by mechanical actions; the *chemical phenomena* accompanying them; or the existence of *electromotive forces* acting in simple contact of two bodies chemically or physically different. Coulomb and Becquerel have held the first view. Wollaston considered the electricity in frictional machines was due to an alteration of the oxidisable amalgam of the cushions; but, after Gay-Lussac and Peclet made a machine act in dry carbonic acid, the chemical explanation was abandoned. The third-mentioned view has been enunciated by Peclet, Gaugain, and others.

M. Joulin was attracted to the subject by phenomena of electricity of tension observed in leather belts employed in some factories he visited. He got machines constructed so that the mechanical tension of the belt could be varied at will (drawings of these are given in elevation and plan). The motor pulley was mounted on fixed supports, the moved pulley on sliding supports, and the tension was varied by means of weights connected by a lever, &c., with these sliding supports. The conducting bodies employed for pulleys were iron, brass, zinc, red copper, white iron, lead (the last four metals applied in their laminæ to wooden pulleys); the imperfect conductors, walnut-wood, leather, hardened caoutchouc, in laminæ of 12 m.m. thickness applied to wood; cloth and silk fastened in the form of cushions on wooden pulleys. The pulleys were of various dimensions and form.

(The author further describes the variations of conditions of movement in these new machines, and the modifications the belt underwent in hygrometric and elastic state. In the next chapter he explains the process of measuring the electric tension. The fourth is a study of the distribution of electricity; and the fifth treats of the variations of electric tension with different circumstances, nature and state of the bodies, form and dimensions of pulleys and belts, and temperature). The following is a *resumé* of M. Joulin's conclusions:—

The new machines, formed of a metal and of leather, a substance of imperfect, but sufficient conductivity, present, in the latter body, electric tensions of surprising intensity. Independently of the long aigrettes and sparks which could be had, a metallic wire brought near the belt was traversed by a continuous current powerful enough to deflect the needle of a galvanometer with electricity of tension, to weakly decompose water, and, in slightly modified Geissler tubes, to produce a distinct stratification of the electric light. A study of the distribution in different parts of the machine shows that the electricity developed at the moment of separation of the two bodies spreads over the leather in virtue of the laws of conduction, and produces in it a permanent state of current, to which corresponds the free electricity perceived.

The first experiments gave proof of the enormous influence which the two essential conditions of the movement—viz., velocity and mechanical tension, varying within much wider limits than those of previous experiments—have on electric tension. It was sought to determine the variations of this latter infunction of the velocity and the mechanical tension simultaneously with the influence of the other circumstances studied. The state of movement of the electrified body, and the rapid variation of the tension, necessitated the employment of a new method for measuring the electric tension, based on the observation of the greatest distance at which was produced the aigrette of minimum intensity, perceptible in the same sphere brought near to the electrified body. It was found that, all other things equal, with two bodies of given nature, cast-iron and leather, when the velocity is made to vary in a continuous manner, the traction of the belt remaining constant, the electric tension varies algebraically in a manner also continuous, and that when the traction is varied, the velocity remaining constant, the electric tension varies in a continuous manner, either algebraically or in numerical value. If the velocity and the traction vary simultaneously, there is a superposition of their effects in the electric tension. Lastly, the proportionality of the variations of electric tension to the variations of each of the conditions of movement appears, within certain limits, to be the first approximation of the law of variation. Observation as to the influence of the various circumstances, dimensions of different parts of the machine, temperature of the system, or of one of the bodies only, state of surface, equally showed the continuity of variation (algebraic or in numerical value) of the tension, and the superposition of effects if several circumstances are made to vary at once. Endeavouring to synthetise the results, one is led to say that, for the same couple, the circumstances influencing the electric production may be referred to three causes—separation, more or less rapid, of the bodies; the complex mechanical action of incurvation, depending, in the case of leather, on elastic state and dimensions of the pulley, and the number of incurvations in a given time; lastly, the common temperature of the two bodies, or that of one of them.

The algebraically-continuous variation of the electric tension seems to show that there is not occasion to consider, so much as has been done hitherto, the sign of this tension. And if we compare the results obtained with the new machines with effects previously observed, it will be found that the nature, the state, the dimensions of the bodies, and the temperature intervene most often in a manner contrary to that which has hitherto been supposed. It is probable that, when electrification shall have been studied sufficiently, the general law of variation will be discovered; it will then be possible to abandon all these entities—friction, pressure, exfoliation, cleavage—and to say that the phenomena of electric tension always accompany the separation of two bodies the surfaces of which have been brought so close together that the molecular forces have been called into action.

"The algebraic variation" (M. Joulin goes on to say) "of the electric tensions, with the continuous variation of circumstances, and the displacement of the point where the tension is *nil*, along the scale of variations of circumstances studied, have seemed to me of a nature to confirm the ideas which led Franklin to create his terminology; ideas the expression of which will in vain be sought for in the works of the eminent American. Varying in a continuous manner, then, the electromotive force produces tensions successively negative and positive, connected with one another by the law of continuity; and we perceive that the point where the tension is *nil* has not the importance which has been accorded to it hitherto; that it is a simple accident in the scale of variations of electric tension, due, perhaps, to the equality of the electric state of the body with that of the surrounding medium; and that it is from having magnified this fact that so many anomalies have been accumulated in the chapter of production of electricity by mechanical action. For the rest, it is not the first time that this law of algebraic continuity has been met with.

In thermo-electricity, M. Becquerel has long since made us acquainted with couples which, on the temperature of one of the joints being gradually elevated, give currents increasing in intensity up to a certain temperature, decreasing above that to zero, changing direction and increasing anew. Whatever difference there may be in the manifestation of the electric force here by a current, in one experiment by phenomena of tension, it may be admitted that in both cases this force varies in a continuous manner; and the new experiments thus lend support to the theoretical conclusions arrived at by M. Le Roux in his admirable researches on thermo-electric currents.

THE MAGNETISATION OF STEEL.

By E. BOUTY.

(1). Let the circuit comprise only a battery of constant current and the magnetising bobbin. Then slowly introduce a recently-tempered steel needle. It acquires a total determined magnetism at the end of a period which appears not to exceed that of its introduction. On slowly withdrawing the needle it is found to retain residual magnetism, which, together with the total magnetism, increases with each repeated introduction until a limit, A, is reached. The value of the magnetic moment, y, at the end of x passages, is sufficiently represented by the empiric formula—

$$y = A - \frac{B}{x} \quad . \quad . \quad . \quad . \quad (1)$$

where $A - B =$ the residual magnetic moment after the first passage.

This curious augmentation depends essentially on the intermitting action of the current, since its continuance is ineffectual to produce it. It cannot be attributed to the action of induced currents produced by the needle's entrance and exit, because they are far too weak to modify the magnetisation. It must therefore be admitted that the magnetic equilibrium which succeeds to the current's action modifies the distribution of the magnetism in such a fashion that a second application of the same force, acting under the same conditions, is able to add to the total and residual magnetism.

The needle may be magnetised in the bobbin by three other methods:—

1. Establishment (*Etablissement*).—Introduce the needle; establish the current; slowly withdraw the needle.
2. Interruption (*Interruption*).—With a closed circuit introduce the needle slowly, break the current, and withdraw the needle.
3. Instantaneous Charge (*Decharge Disruptif*.—Introduce the needle; establish and break the current; withdraw the needle.

Repetitions of either of these three processes (all things being equal) insures an augmentation of the needle's magnetic moment, and its value y is represented by the formula already quoted. It should be, however, remarked that the limit A varies slightly, according to the method employed.

(2). Should the circuit include two bobbins,

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* Paper read before the Academie des Sciences, at Paris.

P and Q, the extra currents complicate the observed phenomena. Let P be much more powerful than Q, and the one placed continuously with the other. Then a needle magnetised by a great number of passages into the bobbin Q. to the corresponding limit, experiences a quick increase by the breakage of the circuit. The increase obtained in P, under similar circumstances, is insignificant. Thus the direct extra current of P is sensible in Q, and *vice versa;* but the extra current of each bobbin has an action which is absolutely exterior to it.

(3). When the circuit comprises two bobbins the slow introduction of a soft iron core into one of them, or its withdrawal, is without appreciable effect on the magnetism of a needle placed in the other. Should, however, such a core be slowly introduced, and sharply withdrawn, the direct induced current augments the magnetic moment of the needle placed in the other bobbin; and repeated insertions and withdrawals very rapidly saturate the needle to the limit y after x passages, which is conveniently represented by—

$$y = A + B(1 - e^{-ax}) \quad . \; . \; . \; . \quad (2)$$

where A, B, and a are constants. The results are the same when the circuit includes an electro-magnet whose armature is brusquely broken away.

(4). With a bichromate of potash battery set up for several days, and consequently presenting the phenomena of the polarisation of the electrodes, and with a single bobbin, the establishment of the current increases the magnetic moment of the needle magnetised by the passages of a quantity of electricity more or less considerable: the current possesses then, at the moment of its closure, a much greater intensity than that which it retains an instant after. When the helix resistance increases the polarisation diminishes, and the characteristic effect of the ESTABLISHMENT tends to disappear.

As to the interruptions, they have not a well-marked effect upon the needles, at least so long as the resistance of the bobbin is not very great. But in that case, in a strongly-magnetised needle, with its south pole to the left of the principal current, one obtains, by the breakage of the current, a diminution of the magnetic moment. The direct extra current of the bobbin, without effect in its interior, augments momentarily the polarisation of the battery, whence is a very sensible depolarising current (immediately after the breakage) which partially demagnetises the needles. Here there is a reflex action.

If the circuit contains a very strong bobbin, A, and a very weak one, B, the direct extra current of A and the reflex action proceeding from the polarisation succeed each other in B, and produce a very odd effect. The interruption of the current greatly augments the magnetic moment of a needle, magnetised to its limit in B; but the same operation diminishes the moment of a strongly-magnetised needle when placed in B with its south pole to the left of the principal current.

WIRES AND THEIR PROPERTIES.

By J. T. SPRAGUE.

(Continued from page 201.)

THE accompanying table (p. 213) of the relations of the most common and generally useful sizes of copper wire has been calculated by the formulæ given on p. 200, and by means of the constants added to the table the equivalent figures for iron, German silver, and brass wires are readily ascertained. The last line, the "Mil," gives the various constants for use with the square of the diameter of any sized wire according to the formulæ on p. 200. Line 53, the foot-grain, gives a series of constants which may be used in exactly the same manner and by the same formulæ, substituting w, the weight in grains per foot, for d^2, the sectional area: this would save the reduction from the weight into the diameter when the latter could be ascertained only from the weight.

The diameter has been given in millimetres for convenience of reference when that measurement is used, and line 31, the values of a millimetre wire, can be substituted in the formulæ for the "mil" when required; as also line 43, the metre-gramme, may be used in the same way as mentioned for the foot-grain.

Temperature plays a very important part in the resistance of wires; in fact it is difficult to get the same resistance twice for a piece of copper wire, if it is touched, or if the slightest change takes place in the room. Tables of correction are given in many works, but in no single instance has it been pointed out that these tables only give a part of the correction required; they deal only with the temperature of the wire itself, but leave out of sight altogether the variation which takes place in the *measurement instrument itself,* though this is one-tenth of that of the copper wire as regards external temperature, and greater than that of the wire as regards any heat produced by the current itself. The latter cannot be well dealt with except by careful valuation in each case; but for ordinary resistence measurement, with small and momentary currents, the first element alone need be considered. Instruments for measuring resistance ought to have marked upon them the temperature at which they are correct, and for convenience of use this should be the legal standard temperature, 62° F. or 60°; then the correction for actual temperature, say in copper wire, would be not that for copper merely, as given in the usual tables, but this less the simultaneous variation of the German silver wire of the instruments. Thus for each degree Fahrenheit near about 60°—

Copper varies as	1·00215	log.	0·0009327
German silver varies as...	1·00024	,,	0·0003126
True correction	1·00191	,,	0·0008287

The variation occurs not equally for each degree, but by a curve represented according to the experiments of the British Association Committee on Electrical Standards, by the formula for the resistance R at temperature t (Centigrade) from the resistance r at zero, $R = r(1 + at \pm bt^2)$.

	a		*b*
Pure metals... ...	0·003824	+	0·00000126
Mercury	0·0007485	−	0·000000398
German silver ...	0·0004433	+	0·000000152
Platinum silver ...	0·00031		

But for all ordinary purposes the correction above given will suffice, multiplying the decimal portion or the logarithm by the number of degrees (not by the logarithm of the degrees), and multiplying the resistance observed for higher temperature, and dividing for lower temperature; adding or subtracting, as required, the logarithmic correction to the logarithm of the observed resistance.

PROPERTIES OF COPPER WIRE.—SPECIFIC GRAVITY 8·9.

	I.		II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
	B. W. Gauge.		DIAMETER.		Sectional area in circular Mils. (d^2)	WEIGHT.		LENGTH.	RESISTANCE as Pure Copper at 60° Fahr.	
Number.	Holtzapffel.	Common.	In Mils. = ·001 inch. (d)	Millimetres.		Grains per foot. (w)	Pounds per 1000 feet	Feet per pound.	Feet per Ohm.	Ohms per pound.
1	1 inch		1000·	25·4	1000000·	21176·1	3025·17	·33056	96744·7	·00000342
2	1	1	300·	7·61	90000·	1905·5	272·27	3·67	8706·7	·0004218
3		2	280·	7·11	78400·	1660·2	237·17	4·22	7584·8	·0005559
4		3	260·	6·60	67600·	1431·5	204·50	4·89	6539·9	·0007477
5	¼		250·	6·37	62500·	1323·5	189·07	5·29	6046·5	·000875
6		4	240·	6·10	57600·	1219·8	174·25	5·74	5572·5	·001030
7	5	5	220·	5·59	48400·	1024·9	146·42	6·83	4682·4	·001459
8		6	200·	5·08	40000·	847·1	121·01	8·26	3869·8	·002135
9		7	185·	4·69	34225·	724·8	103·54	9·66	3311·1	·002917
10	7		180·	4·57	32400·	686·1	98·02	10·20	3134·6	·003255
11		8	170·	4·31	28900·	612·0	89·46	11·18	2861·0	·003907
12		9	155·	3·93	24025·	508·8	72·68	13·76	2324·3	·005920
13		10	140·	3·55	19600·	415·0	59·29	16·87	1896·2	·008894
14	⅛	11	125·	3·17	15625·	330·9	47·27	21·16	1511·6	·013995
15	11		120·	3·05	14400·	304·9	53·56	23·28	1393·1	·016478
16		12	110·	2·79	12100·	256·2	36·69	27·32	1170·6	·023337
17		—	100·	2·54	10000·	211·8	30·91	33·06	967·5	·034168
18	13	13	95·	2·41	9025·	191·6	27·30	36·63	873·1	·041950
19		14	85·	2·15	7225·	153·0	21·12	46·28	691·0	·066980
20		15	75·	1·92	5625·	119·1	17·02	58·77	544·2	·10799
21		—	70·	1·778	4900·	103·76	14·82	67·46	475·1	·14241
22	16	16	65·	1·651	4225·	89·47	12·78	78·24	408·8	·19141
23			62·5	1·587	3906·	82·72	11·82	84·62	386·7	·22392
24		—	60·	1·521	3600·	76·23	10·89	91·82	348·3	·26370
25		17	57·	1·440	3249·	68·80	9·83	101·75	314·3	·32369
26		18	50·	1·274	2500·	52·94	7·563	132·22	241·9	·54669
27		19	45·	1·143	2025·	42·88	6·126	163·25	196·0	·83324
28		—	43·	1·092	1849·	39·16	5·593	178·78	178·9	·99940
29	19		42·	1·066	1764·	37·36	5·236	187·39	170·7	1·0981
30		20	40·	1·016	1600·	33·88	4·840	206·60	154·8	1·3347
31	mllmtre.		39·37	1·	1550·	32·823	4·689	213·26	151·0	1·429
32	20	21	35·	·889	1225·	25·941	3·705	269·84	118·5	2·278
33	21	22	32·	·813	1024·	21·684	3·101	322·81	99·1	3·259
34		—	30·	·762	900·	19·059	2·729	367·29	87·1	4·218
35	22	23	28·	·711	784·	16·602	2·371	421·63	75·9	5·559
36	23	24	25·	·635	625·	13·235	1·891	528·90	60·5	8·747
37		25	23·	·584	529·	11·202	1·604	624·88	51·2	12·210
38	25		20·	·508	400·	8·470	1·213	826·40	38·7	21·355
39		26	19·	·483	361·	7·648	1·092	915·78	34·9	26·219
40	26	27	18·	·457	324·	6·845	·991	1020·3	31·4	32·549
41	27	28	16·	·406	256·	5·421	·774	1291·3	24·8	52·137
42		29	15·	·381	225·	4·765	·681	1469·1	21·8	67·493
43	metre gramme.		14·9	·379	222·13	4·704	·672	1488·1	21·5	69·250
44	28	30	14·	·355	196·	4·151	·593	1690·4	19·0	88·943
45	30	31	12·	·305	144·	3·049	·435	2295·6	13·9	164·78
46	31	32	10·	·254	100·	2·118	·303	3305·6	9·7	341·68
47		34	9·6	·244	92·16	1·952	·279	3586·8	8·9	402·29
48	32		9·	·228	81·	1·715	·246	4081·0	7·8	520·78
49		35	8·7	·221	75·69	1·603	·229	4367·3	7·3	596·41
50	33		8·	·203	64·	1·355	·194	5165·0	6·2	834·19
51		36	7·9	·200	62·41	1·322	·189	5296·6	6·0	877·23
52	34		7·	·177	49·	1·038	·147	6746·1	4·7	1423·1
53	Foot-Grain.		6·872	1·75	47·22	1·	·14286	7000·	4·5684	1532·2
54		37	6·7	·170	44·89	·951	·136	7363·7	4·3	1695·6
55		—	6·	·152	36·	·762	·109	9182·2	3·5	2636·4
56		38	5·8	·147	33·64	·712	·102	9826·4	3·3	3019·3
57		—	5·5	·139	30·25	·641	·092	10902·	2·9	3734·0
58	35		5·	·127	25·	·529	·0756	13222·	2·42	5466·9
59		39	4·2	·106	17·64	·374	·0534	187[illegible]9·	1·71	10981·
60	36		4·	·106	16·	·339	·0484	20660·	1·55	13347·
61		40	3·9	·099	15.21	·322	·0460	21732·	1·47	14769·
62		41	3·3	·084	10·89	·231	·0329	30354·	1·05	28812·
63	Mil.		1·	·0254	1·	·0211761	·0030252	330560·	·0967447	3416825·

To convert from copper to other metals use the following constants:—

				Log.
1.	WEIGHTS. Multiply by	Iron	·87641	$\bar{1}$·9427046
		German Silver ..	·977538	$\bar{1}$·9901293
		Brass	·94382	$\bar{1}$·9748893
2.	LENGTHS. Multiply by	Iron	1·14003	0·0572954
		German Silver ..	1·02298	0·0098707
		Brass	1·05952	0·0251107
3.	RESISTANCE. Multiply by	Iron	5·3149	0·7254969
		German Silver ..	12·2009	1·0863826
		Brass	4·54	0·6570559

4. LENGTH OF RESISTANCE (Col. VIII.) divide by the foregoing constants, which are the conductivities, copper being 1. In ike manner the conductivity of any commercial copper or other metal will give the correction to employ.

CALORIFIC EFFECTS OF MAGNETISM IN AN ELECTRO-MAGNET OF SEVERAL POLES.

By A. CAZIN.

I HAVE arrived at the following simple law regarding the calorific effects which accompany the disappearance of magnetism in the core of a straight electro-magnet presenting several *consequent points*:—

When a core of bar iron is magnetised by a series of similar bobbins, traversed by the current in alternately opposite directions, and if these bobbins determine equal concamerations, the quantities of heat created in the core by the disappearance of the magnetism are inversely proportional to the squares of the numbers of concamerations.

The apparatus used consisted of a sort of differential air-thermometer, whose two reservoirs, containing air, were united by a bent glass tube containing water. As the air in either reservoir expanded or contracted, the water in the tube was thrown out of its level, and thereby measured the effect of the heat upon the air: in other words, it served as a sort of manometer, to measure the difference of pressure H between the two reservoirs. To ensure the same conditions to the two reservoirs, in relation to surrounding bodies, they were both enveloped in a layer of cotton, and in a pasteboard tube; then they were placed into the axes of two similar wooden bobbins, without allowing the wood and pasteboard to touch each other. The copper which received the current was twisted round one of the series of bobbins, and magnetised the corresponding core. These precautions were necessary to prevent the voltaic heat from being transmitted to the core.

In experimenting, an intermitting current is sent into the magnetising bobbins; an indicator registers the number n of the breaks; the difference of the levels in the manometer are noted every minute, and, when the current is suppressed, the manometer is watched until the first level is obtained again. These data indicate on the one part the total effect H of the intermitting current, and on the other part the correction h due to the cooling action of surrounding bodies. $\frac{H+h}{n}$ = the effect of the disappearance of the magnetism at each break of the circuit, and also relatively the heat created by the magnetism.

This experimental law is conformable to the law of *magnetic energy* before communicated to the Academy. Call m the quantity of magnetism which the core imbibes when the current traverses four bobbins in the same direction without forming consequent points; call l the distance of the two poles. The quantity of heat created by the disappearance of this magnetism is measured by $m^2 l$.

Let us suppose the current to change its direction once, so as to have one *consequent point* in the middle of the core. The core will then behave like two independent cores together, of which *each* possesses the quantity of magnetism $\frac{m}{2}$, with a polar distance of $\frac{2}{l}$, and produces the quantity of heat $\frac{m^2}{4} \times \frac{l}{2}$. The total heat is then $\frac{m^2 l}{4}$, which is the experimental law.

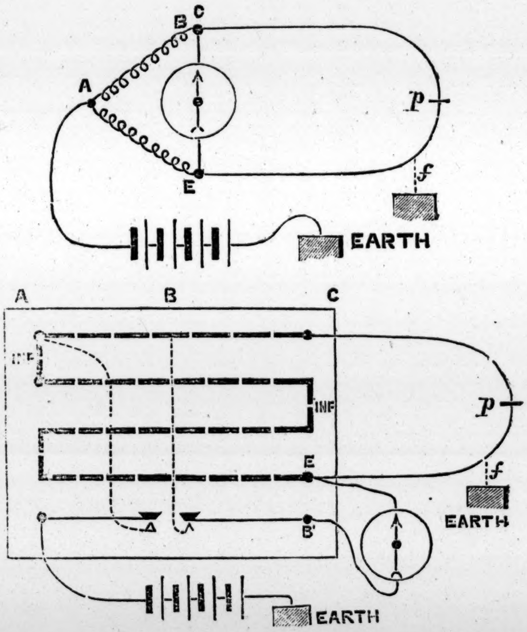
Students' Column.

Resistances and their Measurement.—By H. R. KEMPE.

X. *The Loop Test.*—

When a faulty cable is lying in the tanks at a factory so that both ends of it are at hand, or when a submerged cable can be looped at the end furthest from the testing-station with either a second wire, if it contains more than one wire, or with a second cable which may be lying parallel with it, as is often the case, then the simplest and most accurate test for localising the position of the fault is the loop test. The accuracy of the loop test is owing to its being independent (within certain limits) of the resistance of the fault, thus doing away with the necessity of cleaning and depolarising it as would be necessary in the ordinary tests. There are two ways of making this test with the form of apparatus hitherto described. Fig. 13 shows the theoretical and practical arrangements for making this test by the first method. p is the point where the two wires or cables are looped together at the further station, f being the fault.

FIG. 13.



Let x be the distance from C to the fault, y the distance from E to the fault. Then AB and AE being adjusted until equilibrium is produced—

$$AB \times y = AE \times x.$$

Let L be the total conductivity resistance of the whole loop, then—

$$x + y = L,$$

therefore—

$$x = L - y.$$

Substituting this value of x in the above equation, we get—

$$AB \times y = AE(L - y),$$

from which—

$$y = L\left(\frac{AE}{AE + AB}\right).$$

To obtain L, we should simply join up for the ordinary conductivity test, as shown by Fig. 12 in the last article. The fault in this case has no effect upon the test, provided it is not caused by the complete fracture of the cable, for in such a case the broken ends become covered with salts, which would make the resistance appear higher than it really is. When, however, the fault is due to a simple imperfection in the insulating sheathing, the ordinary conductivity test gives the correct result. It is advisable to keep a record of the conductivity resistance, so that it can be ascertained at any moment when required without the necessity of making a measurement. In the practical execution of this loop-test, the connections being made as shown in the figure, all the plugs between B and C must be inserted. This is necessary, because the galvanometer connection is made on to the terminal B′, which is the same as B, instead of on to C. The test could be made by placing the galvanometer on to C, but in that case we should lose the advantage of the key, which it is always best to use. The plugs being inserted between B and C, and the infinity and other plugs being in their places, we should remove the 1000 plug from between A and B, and having pressed down the left hand key so as to put the battery current on, which should be a *zinc* one as shown, we should adjust the plugs between D and E, pressing down the right hand key as required until equilibrium is produced. The different resistances being inserted in the formula, y is found, which, being divided by the conductivity resistance per mile of the cable, gives the position of the fault.

Example.—A cable 50 miles long, whose total conductivity resistance was 450 ohms, that is, 9 ohms per mile, was looped with a second cable, whose length and conductivity resistance was the same as the first cable,—the resistance of the loop being $450 \times 2 = 900$ ohms. The adjusted resistance in AE to obtain equilibrium was 200 ohms, AB being 1000 ohms. Then—

$$y = 900\left(\frac{200}{200 + 1000}\right) = 150 \text{ ohms}.$$

Dividing this by the conductivity per mile, which is 9 ohms, we get distance of fault from testing-station equals $\frac{150}{9} = 15\frac{5}{9}$ miles.

Fig. 14 shows the second method of making the loop-test. In this test, BC and AB are usually made equal, AE being adjusted until equilibrium is produced. Then—

$$BC(AE + y) = AB\,x$$

and

$$x = L - y.$$

therefore—

$$BC(AE + y) = AB(L - y),$$

from which—

$$y = \frac{AB \times L - BC \times AE}{AB + BC}$$

If $AB = BC$, then—

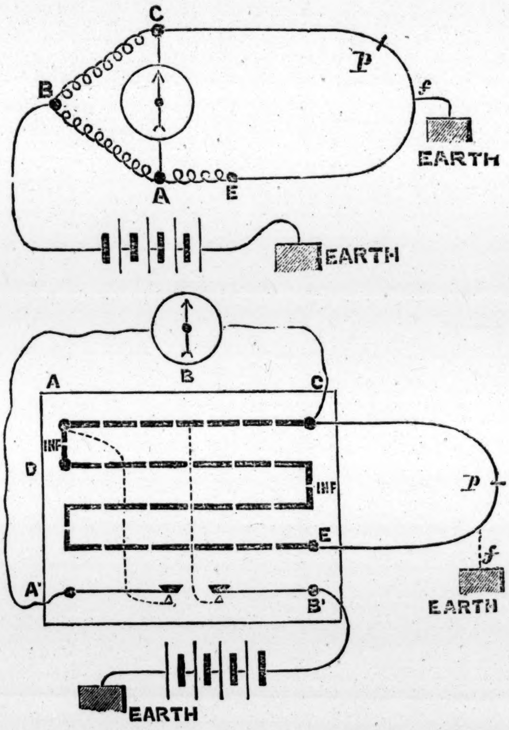
$$y = \frac{L - AE}{2}$$

Example.—The two cables being of the same length and conductivity as in the last example, equilibrium was obtained by making $AE = 600$. Then—

$$y = \frac{900 - 600}{2} = 150 \text{ ohms}.$$

It is necessary that the faulty one of the two looped cables be attached to E, or else it would be impossible to obtain equilibrium. If we were testing a looped cable, and after having joined it up found that we could not obtain equilibrium, we may be sure that the fault lies between C and p. The cable must then be reversed, and a fresh test made.

Fig. 14.

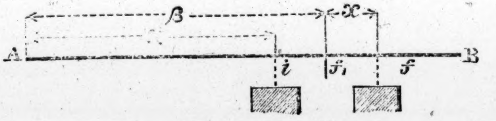


The two looped cables may have different conductivities per mile. In this case we must divide the 150 ohms by the conductivity per mile of the cable in which y is measured.

When the position of a small fault,—that is to say, a fault which has a high resistance,—in a short piece of cable, or underground work, has to be localised by the loop test, it is necessary to use a galvanometer which has a low resistance. For if its resistance is high, the short looped wire acts as a short circuit, and very little current can pass through the galvanometer; still less can pass through it if the fault has a high resistance. If, then, it is required to localise faults in short lengths of cable, or underground work, such, for instance, as the underground work in the streets of large towns, it is advisable to have a galvanometer specially constructed for the purpose, of thick wire.

It sometimes happens that the fault in a cable has a resistance approaching that of its insulation resistance when sound, then the position of the fault as indicated by the loop test will not be its true position. The reason of this is that the current flowing in a faulty cable has two paths open to it, one through the fault and the other through the whole of the insulating sheathing. The cable, in fact, possesses two faults, the actual fault, and the fault due to the conducting power of the insulating sheathing. This second, or *resultant* fault, as it is called, in a homogeneous cable is equivalent to a fault in the centre of the cable whose resistance is equal to the insulation resistance of the cable itself when in good condition. If the cable is not homogeneous throughout, this resultant fault will lie away from the centre. Its position can be found, however, by the ordinary loop test when the cable is sound. We have then to determine the true position of the fault when the position and resistance of the resultant fault and also the insulation resistance of the cable when imperfect, together with the position of the fault as indicated by the ordinary loop test, are known.

FIG. 15.



Let AB be the looped cable or cables where—

i = resultant fault;
f_1 = apparent fault;
f = actual fault.

Now, f, the insulation resistance of the faulty cable, is compounded of the resistance of the true fault and the insulation resistance of the cable when good, that is—

$$f_1 = \frac{f\,i}{f+i}\text{; therefore } f = \frac{f_1\,i}{i-f_1}.$$

Also—

$$i : f :: \text{distance between } i \text{ and } f_1 : x$$

$$\text{distance between } i \text{ and } f_1 = \beta - \alpha;$$

therefore—

$$i : f :: \beta - \alpha : x;$$

therefore—

$$x = f\frac{\beta-\alpha}{i} = \frac{f_1\,i}{i-f_1} \cdot \frac{\beta-\alpha}{i} = \frac{f_1}{i-f_1}(\beta-\alpha),$$

which gives the true position of the fault beyond the apparent position.

Or the distance of the fault from A will be—

$$\beta + \frac{f_1}{i-f_1}(\beta-\alpha) = \frac{\beta i - \alpha f_1}{i-f_1}.$$

Thus, for example. In a looped cable, whose total length was 100 miles, and total conductivity resistance 900 ohms, the ordinary loop test showed the apparent position of a fault which existed in it to be 700 ohms from A, that is—

$$\beta = 700.$$

The position of the resultant fault given by the loop test when the cable was new was found to be 500 ohms from A, that is—

$$\alpha = 500.$$

The insulation resistance of the cable when new was 3,000,000 ohms, and when faulty 600,000 ohms, that is—

$$i = 3{,}000{,}000$$
$$f_1 = 600{,}000$$

where is the true position of the fault.

Distance of fault from A =

$$= \frac{700 \times 3{,}000{,}000 - 500 \times 600{,}000}{3{,}000{,}000 - 600{,}000} = 750 \text{ ohms.}$$

That is to say, distance of fault beyond distance given by loop test is—

$$750 - \beta = 50 \text{ ohms.}$$

or, supposing the cable to have a resistance of 9 ohms per mile, the true distance of the fault beyond the apparent distance will be $\frac{50}{9} = 5\frac{5}{9}$ miles.

If in the equation—

$$\text{Distance of fault from A} = \frac{\beta i - \alpha f_1}{i - f_1}$$

we put $i = \alpha$, or, what is the same thing, $\alpha = \beta$, then—

$$\text{Distance of fault from A} = \text{B},$$

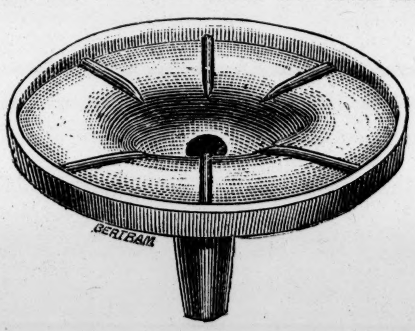
as in the ordinary loop test.

In making the first loop test, it is advisable to use as high numbers as possible in A C and A E, because then we can determine the position of the fault to a greater degree of accuracy than when low numbers are used. For, supposing we started with 10 ohms in A B, and obtained equilibrium very nearly with 5 in D E, then the only other resistance we can insert will be 4 or 6 ohms,—we can have no finer adjustment; but if we used 1000 ohms in A B, and obtained adjustment nearly with 500 ohms, it is evident that there are 100 numbers from 500 to 400, or from 500 to 600, which we can use to get exact equilibrium.

(To be continued).

New Inventions.

MESSRS. WATTS AND Co., of Baltimore, an enterprising firm of telegraph material and electrical apparatus makers, have invented a novel and effective Battery Insulator, of which we give an illustration. The insulator is very simple, and is intended to be inserted into a hole bored through the battery frame when the cell or cells of the battery are placed upon it. From its peculiar form these cells are maintained free from moisture, because it drips directly to the frame-stand or into a trough arranged for the purpose. The insulators can be made of any insulating material, but are mostly manufactured of glass and porcelain. Already they are extensively used in America, and Mr. Prescott, electrician to the Western Union Telegraph Company, predicts that they will come into general use. That gentleman's opinion is the result of an actual personal acquaintance of the use of over fifteen hundred of them.



Proceedings of Societies.

SOCIETY OF TELEGRAPH ENGINEERS.

An ordinary meeting of this Society (the last meeting previously to the summer recess) took place on Wednesday evening, the 13th of May. Mr. Latimer Clark occupied the chair.

The discussion on Mr. **Langdon**'s paper "*On the Decay and Preservation of Telegraph Poles*," which had been adjourned from the 25th of March, was resumed.

Mr. **Langdon** said that by the kindness of Mr. Culley he was able to furnish specimens of that partial system of creosoting timber which was referred to in the paper. Mr. Golsten had also sent one of the poles which was planted on the Portsmouth branch in 1848-9. This was removed during the last month on purpose to be brought to this meeting as an example of the durability of creosoted timber. Lieut. Ramsay had supplied a specimen of a Boucherised pole planted about three years ago. It was broken off short by the ground line. This supported a statement made in the paper to the effect that all the preparations which were used to arrest decay tended to destroy the flexibility of the timber. During the last discussion Mr. Clark asked whether any one had ever heard of a case of decayed creosoted timber. That induced him (Mr. Langdon) to write to several gentlemen and ask whether such a case had ever come to their knowledge. He had received answers from Mr. Newman, of the London and North Western Railway; from Mr. Warwick, of the Midland Railway, who had had thirteen years' experience of creosoted timber; from Mr. Cripps, of the London, Brighton, and South Coast Railway, who had had six or seven years' experience; from Mr. Haynes, of the Bristol and Exeter Railway, who had had eleven years' experience; and from Mr. Sach, of the Great Eastern, who had had twelve years' experience; and they all agreed that creosote was the best preservative which they had had under their observation, and the only one which had given perfect satisfaction. Not one of them had any knowledge whatever of a decayed cresoted pole. Mr. Webber had, however, forwarded to him a specimen of what he termed creosoted timber. It was in a state of great decay. This piece of wood was accompanied by a letter, in which Mr. Webber stated that the specimen was selected from numerous other pieces which were decayed to an equal extent. They had been in use seven or eight years in a bridge near Totnes on the South Devon Railway. The timber was in gravelly soil, and in such a position that water could drain through it under the railway. The writer added, "On the other hand, last summer I saw some creosoted poles cut which had been in the bed of a tidal river for twenty-eight years. They were as sound as when first put in."

Mr. W. H. **Bateman** had called his (Mr. Langdon's) attention to an error which had crept into the paper. It was stated that sulphate of zinc was used in one of the processes. It should have been chloride of zinc. He had received a letter from Mr. Saunders casting doubt upon the statement made by Mr. Haynes as to the present existence of iron socketed poles upon the Bristol and Exeter Railway. He (Mr. Langdon) had entered into correspondence with Mr. Haynes on the subject, and not only did Mr. Haynes adhere to his statement that there were standing, at the present moment, several of the poles originally planted, but he had sent him one as a specimen. The pole which had been sent had the slots of the old arms which had been originally fixed for the No. 3 insulators, and this fact identified it as one of the original poles. Mr. Woods, who was connected with the same section of the line on which the poles were planted, confirmed the statement made by Mr. Haynes. Hence it was only fair to conclude that Mr. Saunders must have made a mistake.

Mr. **Spagnoletti** said that the subject of the paper was one of considerable interest to those who had charge of pole telegraphs, because timber formed the greatest item of their expenditure. Therefore anything which would prolong the life of a pole was of great importance. His experience of several years showed him that as much depended upon the selection of the timber as upon the mode of preparing it. Good hard mountain grown larch, which had been felled in the proper season, and well seasoned before being fixed, would last from seven to ten years without any preparation. If it was very good, or extra quality, it would last rather longer. Tarring and charring, he believed, was good, as the process prevented the chance of vegetation attaching itself to the pole. There were very many persons who were opposed to that method. The system of Boucherising did not seem to add much to the life of the pole. He had placed on the table a piece of a pole which was Boucherised and planted in 1866, and was entirely decayed when it was removed in 1872. This was one of a large quantity of poles bought of Sir Robert Harvey. The trees from which they were made were thickly planted and quickly grown, and did not contain more than forty or fifty rings. He believed that one cause of their decay was that the tissues and pores of the pole were so coarse that the moisture which was attracted into the wood would cause the copper preservative compound to dissolve so that it could leak out. In some of the poles there was not the slightest trace of the preservative material, except just in the very heart of the wood. The sulphate of copper had been found very destructive to the iron-work about the poles, especially as the iron-work was of a very light character. The earth wires on the poles were generally only No. 16 gauge, and they were soon destroyed by the sulphate of copper. The same effect was produced on the stay wires and the arm bolts. Some poles might have decayed from the fact of the timber being bad or dead before the process was applied. The next process was Kyanising, which he applied to about fifty-six miles of poles, which were planted in 1855. These poles, with the exception of a few planted in the chalk, were all good to this day. An interesting specimen of Kyanising was a piece of wood which was put down as a longitudinal sleeper on the Great Western Railway in 1840, of which the sap wood was still perfectly good. He was afraid, however, that the effect of Kyanising on the light iron-work would be the same as that of Boucherising. 2 lbs. of corrosive sublimate at 3s. a lb. was sufficient to preserve 50 feet of timber, and the time required for preparing the wood was one day for the inch and one day over. According to Faraday, the corrosive sublimate combined with the sap of freshly cut wood and formed an insoluble compound; but creosoting appeared to be the best system if it was properly performed and if the timber was well seasoned. It had, however, the disadvantage of making the timber exceedingly brittle. Creosote was, however, a very awkward preservative for poles which were placed on public roads or on railway platforms, because the heat of the sun drew the creosote out. He put up some creosoted poles three years ago and found that the banks of the railway were all saturated with creosote for about a yard round the pole. The heat of the sun allowed the creosote to gravitate downwards, and it went to the point which it was wished to preserve. In the case of which he had spoken the vegetation round the pole died. Then creosote was not at all destructive to the iron-work, but he found that in some cases the creosote insulated the earth wire of the arm. With regard to iron sockets there were a good many of them in use. They were tried on the Wootton Basset incline. The poles in these sockets were planted twenty years ago, and they were good to the time at which they were taken down, and some of them were standing now. The only difficulty which he saw in the use of iron sockets was that the size of the pole could not be increased without a new socket being required. Mr. Preece tried the experiment of putting an iron shoe on the bottom of a pole, but all the natural elements of decay were left in the pole. Had the wood been treated with a preservative compound, that compound would have percolated into the casing, and the pole would have lasted a very considerable time. A letter which he had received from an old inspector stated that the writer had never seen a decayed creosoted pole. The writer gave the following account of an experiment which had been tried with creosote:—"I have just turned up an old pole from the Severn Valley line. This pole was experimented upon by being bored from the bottom to the ground line, and another hole bored into it transverely. The bottom was then plugged up, and the hole filled up with creosote and plugged up at the ground line. I split the bottom, and found that none of the creosote had entered the wood. There is not the slightest sign of creosote having entered the wood from the heart of the pole, although it has been poured in from the centre.

Professor Abel said that Mr. Langdon seemed to regard the variability of the preservative action of the copper salt upon Boucherised wood as being due to the washing out of the copper salt. He (Professor Abel) doubted very much whether that was the right cause to which to ascribe it. He believed that the small quantity of copper salt which was introduced by the process combined entirely with certain albuminous portions of the wood, and converted them into insoluble matters. It was by the action which these albuminous substances underwent, through the action of the metallic salt upon them, that the preservative effect was brought about. He did not think that the rotting of the wood in certain instances could be ascribed so much to the washing out of the salt as to the access of air to the wood through the more or less porous soils in which the poles were planted. It was probable that if a pole was fixed in a stiff clay, or in anything approaching the character of a hard rock, the protective action would be much greater than if the pole was set in a porous material like sand or loose earth. About sixteen years ago he had opportunities of making experiments with the Boucherising, Kyanising, and other processes, in the carriage department at Woolwich, and the general results he arrived at were rather favourable to Boucherising. It was found that the wood was rapidly impregnated with the Boucherising material, and after a considerable number of years specimens of Boucherised wood were found to have withstood decay better than samples prepared with other metallic salts. The wood upon which the experiments were made was green timber specially felled. Boucherie himself, as far back as 1841, tried a great variety of salts as well as sulphate of copper, such as the salts of mercury, zinc, lime, and other bases, causing them to be drawn up into the sap of the wood. After several years' examination he came to the conclusion that the copper salt was best. However, he (Professor Abel) believed that opinions were generally and fairly divided between Boucherising and Kyanising. No doubt in the creosoting process there was not only the action of an antiseptic material on the wood, but also the prevention of decay by the exclusion of air. That was the reason why the creosoting process was, generally speaking, a much more efficient process than any treatment with metallic salts. The antiseptic action of the creosote was due to the presence of carbolic acid and cresylic acid; and in former days creosote contained a very large proportion of those important agents. But within a comparatively few years these very substances had become extremely valuable; and in the ordinary commercial creosote they no longer existed in the proportion in which they used to exist. Even as far back as ten years ago, when he examined samples of creosote for one of the large railway companies, he found that there were very great differences in the proportion of carbolic acid and cresylic acid. This variation, no doubt, existed to a much greater extent at the present time. Therefore we were unable to draw safe conclusions from past experiments as to what would be the preservative action of the creosote of the future as far as that action depended upon the antiseptic qualities of the creosote; and it was very likely that we should have to rely upon that one particular action of the creosote in filling up the pores of the wood.

Mr. E. Rolls said that he thought, with regard to foreign-grown timber, that we should be very careful indeed before pronouncing for or against any particular species, they one and all so varied with different conditions of climate, soil, and elevation, that it was all but impossible for any but the connoisseurs of the timber trade to avoid often giving the place of honour to an undeserving species, and slighting a worthier branch. He noticed in the paper that the pitch pine falls under condemnation on the ground,—that after a time the resin, turpentine, &c., which formed its preservative, oozed out, and left only a mass of dry, short, woody tissue. But this could only be the case with some specimens of the genus, for Oregon pitch pine was largely used for the principal spars of vessels, and they demanded, of course, great strength and resistance to decay in all climates. He quite agreed with Mr. Langdon's verdict in favour of larch. All things considered, he thought that larch was next to creosoting. It would stand well for from ten to fifteen years, and then have only a surrounding of decayed pap-wood. If that was knocked off until the sound wood was reached, and the latter tarred, or charred and tarred, the pole would continue to last longer than he could tell. But he was free to confess that this was larch *par excellence*, and hardly to be obtained at the ordinary price of telegraph poles. It was to be found only at certain elevations, and growing upon the poorest soil. It was usual to insist upon natural butts, but this might not always be wise. Larch, even of the best sort, when growing, was frequently found to be foxy or decayed inside the butt, and that without future detriment to the timber. With respect to charring and tarring these and other plain poles, he had always held the opinion that, provided the spar was tolerably seasoned, the process was of great use when properly carried out, but inattention to the theory involved frequently led to inefficient practice. If we took a pole and gently roasted—or, we might say, toasted—it, at a considerable distance from the fire, the first effect would be similar to kiln-drying, or quick seasoning; the next would be to render insoluble the albuminous matter of the wood, and thus prevent it from becoming an active element in the future decay of the pole. So we attained one of the results of Kyanising. If we now brought the pole somewhat nearer the fire, so as to reduce a moderate portion of the outside wood to charcoal (not ashes), we should surround the pole with a powerful antiseptic—carbon. If we coated this with coal-tar we added a second, and still more powerful, antiseptic, in the shape of its creosote, so-called; and the eliminated pitch formed a warerproof envelope. As to Boucherising he quite coincided with Mr. Culley, Mr. Spagnoletti, and others, that the process was of little service, giving very variable results. He had had to renew many Boucherised poles that could claim only an existence of six or seven years, and in one instance less than two. All these were of the ordinary yellow colour; but upon the same line were a number of copper-injected poles of the same kind of wood (Scotch pine), of a blackish colour, and these, although several years older than their yellow brethren, were, with one or two exceptions, perfectly sound. It had occurred to him that possibly the sulphate of copper which was used might have been impregnated with iron-salt, and that the latter, entering into combination with tannic acid, and perhaps gallic acid, existing in the wood, had given rise to the black colour which was found in the interior. He should not expect the tannates or gallates formed in fir or pine to be in sufficient quantities to affect their preservation. Still there naturally presented itself the idea whether an admixture of iron-salt with the copper assisted to prolong the life of a pole. Of Kyanising he had little or no experience. The principle appeared to be correct. The perchloride of mercury ought to render insoluble the albumen of the wood, and the resulting subchloride defend the wood from the attacks of insects and fungi; yet in practice this did not appear to be always borne out, for one of the engineers of the Croydon Atmospheric Railway had informed him that, when that line was in construction, Baltic timber of the best sort was selected for the sleepers, and these were steeped in wooden tanks containing the solution of mercury. The steeping being completed, the sleepers were stacked and the tanks were broken up, and their bottoms were found to be rotten. The bottom sleepers of each stack were also found to be in the same condition. However, with such a powerful ally as creosote, he thought that we might well dispense with the poisonous compound of mercury, attacking the human body as it did externally and internally. Creosoting, properly carried out, answered every purpose perfectly well, and at the present moment it was impossible to say how far it might prolong the life of a pole. He believed that the Egyptian mummy cloths were supposed to have been steeped in a liquid containing this essential principle, and we all know how wonderful was their preservation. With the same luck we should have the poles which Mr. Langdon mentioned as being on the Portsmouth line and others in excellent condition somewhere about the year 6000—rather longer than we were likely to be interested in the matter. In creosote, then, we possessed a preservative fully meeting our requirements, and it only remained to consider the method of applying it. All who had had experience of creosoted poles must have noticed that, under the influence of a single summer, some lost most of their creosote, and became white, dry, and brittle; some were reduced to the same condition less rapidly; while others—and these always from the same batch of creosoting—retained their creosote, and were black and shiny on the exterior, as if pitched, and became harder and harder with age. He believed that these different results were due to the description of creosote used in each case, and that, as a rule, in manufacturing the article, the distillation was carried on too slowly, and the resulting liquid, being necessarily very volatile, was, under the influence of sun-heat, more or less evaporated and drained from the pole. But if the distillation was urged so as to drive over into the receiver a certain amount of tarry matter, we should have the creosote with which the hard black poles had been prepared. He knew of no practical reason why we should fail to obtain this creosote, but, when we did fail to obtain it, doubtless the next best thing was, as Mr. Langdon suggested, to coat the outside of the pole with coal-tar. This, however, could not be so efficient, as it had only a surface effect. There is another point which might perhaps deserve attention. The manager of some creosoting works had told him that poles exposed some time to the sun would no longer take the creosote at any pressure which could be applied. If this was so, it was, of course, of the utmost importance that poles should be seasoned under shade. With respect to the President's question about creosoted poles, he might answer it in the affirmative. On the West Moors section of the South Western Railway he had to renew several poles creosoted to the depth of 1 and 2 inches, and which were in a very bad state. These were all of Norway spruce fir.

Mr. Langdon, in reply, said that he had hoped that the array of telegraph engineers who had had so long an experience of timber, as applied to telegraph purposes, would have favoured the meeting with the results of their experience. The subject was one of unquestionable importance to railway men, and also to the Government. As he had stated in the paper, there would be a saving to the Government of £12,000 a year in poles, if they could only prolong the life of the timber to the extent of three and a half years. If the life could be prolonged for a second three and a half years the saving would be double. The question was, therefore, one of very great importance to the commercial success of telegraphy. If it was conceded that the decay of telegraph poles proceeded from the absorption of the moisture from the soil, it was clear that we must either creosote the pole partially or entirely, or give it such a protection as would exclude the moisture from the portion which was buried in the ground. The effect of creosoting had been so well described by Prof. Abel that he (Mr. Langdon) need not dwell upon it. Every person interested in the matter would feel indebted to Prof. Abel for his remarks. There was no question that creosote had very much depreciated within the last few years as regarded its antiseptic qualities. He hoped that this was a fact which would receive the attention of some gentleman in the next session of the Society. If the decay of the poles arose from the absorption of moisture from the ground, we had an opportunity of employing a cheaper description of timber than had hitherto been used. There would be no reason why we should not employ our home-grown Scotch fir, which might be found to be as strong as larch. It would more readily absorb the creosote when it could be applied; and when creosote could not be applied the Scotch fir would be as well fitted as larch for the application of the compound of pitch or tar. At the last discussion Mr. Bell made some enquiry with reference to poles which were planted on the Basingstoke and Salisbury section of the London and South-Western Railway, about the year 1855. He (Mr. Langdon) was unable to state positively how those poles were renewed, but he believed that there were partial renewals up to 1865, and that in 1865 and 1866 the section was generally renewed. A great portion of the section was renewed in 1872. The poles renewed in 1872 were possibly some of those which were put in in 1866; hence some of them probably lasted six or seven years. He desired to express his thanks to those gentlemen who had contributed to the success of the paper by sending specimens, and also to those who had taken part in the discussion.

The Chairman said that it would be very difficult to over-estimate the importance of this discussion. Timber, on account of its rapid decay, formed a most important and costly item of telegraphic maintenance. It had been assumed throughout the discussion that all the decay of the poles took place at the bottom. No one had alluded to the decay of the upper portions. This, however, had occurred, especially on the western coast of Scotland. Several processes for preserving timber had been described, but there had been an almost universal agreement on the part of the speakers that the creosoting system had proved to be the most successful. Timber might decay in at least two ways:—It might decay by the ordinary process of eremacausis, or slow rotting, and also by the action of fungi. The salts which were employed to prevent decay acted in two different ways: many of them converted the albuminous substances of the wood into insoluble products, and so took away their liability to decay; and some of them acted to a great extent—and especially when the poles were planted on roads which passed through woods—by destroying the mycelium of the fungus, which was a very common cause of the decay of poles. The question of how creosote could be best applied was one to which we had yet to address ourselves. The remarks of Prof. Abel, with regard to the varying qualities of creosote, were of very great importance. That variation was a subject to which telegraphers ought to address themselves in the future. He (the Chairman) having been twenty years ago the engineer of the Electric Telegraph Company, had been compelled to take great interest in the subject of the present discussion, and he originated some of the methods which had been before the last two meetings. The methods devised by him were—the use of iron sockets, the process of tarring and charring, and the boring of a hole in the pole and pouring creosote into it. He had supposed that this last experiment was forgotten; he had recently been repeating it; he could not help attaching some importance to it, and he believed it deserved more attention than it had received. Mr. Walker had written to state that the poles between Redhill and Croydon were mostly the original poles erected by Mr. Cook in 1845: they consisted of Memel timber, Burnetised. Therefore the use of chloride of zinc was a practice to which attention might well be directed. He would, in conclusion, express the very cordial thanks of the meeting to Mr. Langdon for his paper.

A paper "*On the Change of Resistance in High-Tension Fuzes at the Moment of Firing*" was read by Major MALCOLM.

Prof. ABEL, Mr. W. H. PREECE, and the PRESIDENT took part in a short discussion on the subject.

Some "*Notes on Electric Fuzes*" were communicated by Prof. ABEL, but in consequence of the lateness of the hour the meeting was closed without a discussion on this paper.

The abstracts of the above-mentioned papers on electric fuzes, and a report of the discussion, are reserved for our next number.

Notices of Books.

Relazione Statistica sui Telegrafi del Regno d'Italia nell Anno 1872. Florence. 1873.

A COMPREHENSIVE volume, in quarto, published in Rome, giving a full account of the state of the Italian telegraph lines. It is a good sign of the flourishing condition of the science in Italy when we see a work of this kind devoted entirely to statistics. Half of it is composed of tabular matter, amongst which there is a chart demonstrating the progress of the service year by year from 1861 to the end of 1872.

Imperial College of Engineering, Tokei. Calendar Session 1873—1874. Printed at the College, Tokei. 1873.

THE rapid strides with which Japan is becoming assimilated to ourselves, and the great advance the Japanese have already made beyond China and some other eastern nations in civilisation, warrants the supposition that the country will eventually hold the same relative scientific position that we do in the western hemisphere. Any information from Japan respecting her scientific institutions is welcome, and therefore it is with pleasure we notice the above-mentioned work, which Professor W. E. Ayrton has sent to us, and which contains "The Regulations and Syllabus of Studies for the Imperial College of Engineering, Tokei." Mr. Ayrton is a member of the Society of Telegraph Engineers and their Local Honorary Secretary for Japan. As professor of Natural Philosophy at the College, his province includes instruction in magnetism, electricity, and telegraphy; and we doubt not that the learning he will bring to bear upon these important subjects will materially assist his pupils to master one of the most, if not the most, interesting of sciences. The other subjects taught are English, drawing, mathematics, chemistry, surveying and levelling, mineralogy, geology, architecture, general construction, machinery, all the branches of engineering, mining, and metallurgy, &c.

Correspondence.

WIRES AND THEIR PROPERTIES.

To the Editor of the Telegraphic Journal.

SIR,—Mr. J. T. Sprague in his article on "Wires and their Properties" does not seem to have cleared up "*the confusion*" nor "*the great uncertainty which* (he mentions) *exists as to the different gauges*," nor does he furnish a better system for calculating weights and diameters than that which already exists. The system in use is based on the same "*definite principles*" as those he advances for a new standpoint from which to start.

In Mr. A. R. Granville's papers which have appeared at various dates in your Journal under the title of "Formulæ Analysed," the existing formulæ relating to the points dwelt upon by Mr. Sprague are there discussed, viz., diameter, weight, resistance, and conductivity.

In the number of May 1st, in particular, appears the *old* and familiar formula "$\delta = \delta_1 \sqrt{w}$ mils, a general formula in which we obtain the unknown diameter of δ in mils, in terms of the known diameter δ_1." This is precisely similar to $d = \sqrt{w G}$, which Mr. Sprague gives "to ascertain the diameter d of any wire." In like manner a new formula is given "to ascertain the resistance of a copper wire at 60° F., to be used in conjunction with tables replete with logarithms, whereas a very simple formula is already extant for that purpose. This, likewise, has been explained by Mr. Granville in vol. ii., p. 88, of your Journal. The various calculations relating to "Wires" that telegraph engineers use are undeniably simple, concise, and true—qualities which make them very serviceable. Hence, whatever system is intended to supersede them must be simpler, more concise, and truer. They must not be formulæ which on inpection turn out to be *old* friends in new garbs. If Mr. Sprague can furnish such a system he will be conferring a benefit, but the benefit should be one unencumbered with the lengthy calculations in logarithms which seem necessary even to work out the examples he quotes.

Trusting that we shall yet have more, in your columns, from Mr. Sprague in continuation of his papers on the deposition of metals.—I am, &c.,

COPPER WIRE.

SOCIETY OF ARTS.—The Albert Gold Medal of this Society, instituted to reward distinguished merit in promotion of arts, manufactures, and commerce, has been awarded for the present year to C. W. Siemens, D.C.L., F.R.S., "For his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with the economisation of fuel in its various applications to manufactures and the arts."

Electrical Science in English and Foreign Journals.

(In addition to our usual abstracts, there will be found under this heading the titles of papers on electrical science which have appeared in English and foreign journals from the commencement of the present century up to the date of the establishment of this journal).

Poggendorff's Annalen der Physik und Chemie.

Vol. XVI. (1829).

Experiments and Remarks on the Polar Behaviour of the Liquid in the Galvanic Battery, with Reference to Communications on the Subject from MM. Marianini, Pfaff, and De la Rive. M. Pohl. P. 101.

On Irregular Movements in the Daily Action of the Horizontal Magnetic Needle. M. Kupffer. P. 131.

Observations by Dr. Erman of Terrestrial Magnetism in Russia. P. 139.

The Magnetising Power of the Violet Rays. M. Zantedeschi. P. 187.

The Production of Chemical Compounds through Electro-Chemical Forces. M. Becquerel. P. 306.

The Magnetising Property of Sunlight. MM. Riess and Moser.

Vol. XVII. (1829).

The Crystalline Form of Tourmaline, Zinc-Silicate, and Boracit, with reference to the Electric Polarity Produced through Change of Temperature. M. Köhler. P. 146.

On Decomposition of Sulphide of Carbon by Electricity. M. Becquerel. P. 183.

Dr. Erman's Measurements of Terrestrial Magnetism in Russia (Continued). P. 328.

Influence of Heat on Magnetism. MM. Moser and Riess. P. 403.

Hail and the Electric Phenomena of our Atmosphere. M. Ideler. P. 435.

The Thermo-Electric Power of Metals. M. Becquerel. P. 535.

Vol. XVIII. (1830).

The Daily Change of Intensity in the Horizontal Portion of the Magnetic Forces. M. Reich. P. 57.

The Production of Chemical Compounds through Electro-Chemical Forces. M. Becquerel. P. 143.

Measurement of the Intensity of Terrestrial Magnetism. MM. Moser and Riess. P. 226.

The Analogy Presented in the Propagation of Light and of Electricity, and on the Constancy of Actions of Electric Currents which are Compelled to Pass through Spaces which have been Already Traversed by Other Electric Currents. M. St. Marianini. P. 276.

Observations of the Inclination of the Magnetic Needles During a Journey to Ural, Altai, and the Caspian Sea. M. von Humboldt.

Vol. XIX. (1830).

Ether-Formation through Contact-Electricity. M. Lüdersdorff. P. 77.

The Daily Variation of Magnetic Force and Extension of Poisson's Method for Measuring the Intensity of Terrestrial Magnetism. MM. Riess and Moser. P. 161.

The Regular Hourly Variations and the Perturbations of the Magnetic Deflection in Central and Eastern Europe. M. Dove. P. 357.

Comptes Rendus Hebdomadaires des Séances de l'Academie des Sciences, Vol. lxxviii., No. 16.

An Improved Thermo-Electric Battery.—M. C. Clamond.

No. 17.

On the Elemental Law of Electro-dynamic Actions.—M. J. Moutier.—A purely mathematical paper, being an investigation of Ampère's "Theory of Electro-dynamic Phenomena," with the object of formulating Ampère's views having regard to the idea of electricity as the result of a vibratory movement of the ether.

No. 18.

On the Depth of the Magnetised Layer in a Steel Bar.—M. J. Jamin.—Having previously shown that magnetisation penetrates to a finite depth into steel, M. Jamin experimented upon the limit, and the law of the decrease of the intensity from the surface to that limit. It suffices to quote the experiment of the breaking of a magnet to affirm that a bar is composed of threads, or elementary chains, of small magnets, which succeed and join one another by their contrary poles. Granted that these threads are all equal to one another,—that is to say, they are grouped in bundles of the same strength,—he assumes that in their whole length the contrary poles which are in juxtaposition are entirely concealed, in such a manner that the threads are inactive excepting at each extremity, where a single free pole is found. Being inactive, they extend parallelly to the axis in the prismatic bars, as far as the extremities; but, as there are there free poles which repulse each other, they expand by diverging, and terminate at the various points of the free surface, where they develope reactions. Upon each superficial element the intensity is proportional to the number of poles found there, and to the square of the force with which its attraction is overcome. The total number of the threads, or the total quantity of magnetism, is equal to the sum of the intensities on each element,—that is to say, the sum of the square roots of the detaching forces. M. Jamin quotes four points which he set himself to examine:—(1) the sum total of the threads which cross the middle zone of the magnet; (2) the law of distribution in this zone; (3) the sum total of the intensities distributed over the free surfaces; (4) the distribution of these intensities. Four series of steel plates were prepared with thicknesses of 1, 2, 3, 4 millimetres, and each 1 metre long by 50 m.m. broad. After saturating them with magnetism by means of a powerful coil, the magnetism developed on their surfaces was measured. First, the plates were divided into five bands by four equidistant lines running parallel to their length; then on each line, at certain distances, the detaching forces of a small trial contact-piece, suspended to the scales of a balance, were measured. The square roots of these forces represent, at each point touched, the magnetic intensity. The mean of five drawn curves, representing the intensities as measured, was taken, and the author stated—"It is clear that the area of this curve measures the whole of the magnetism, or the number of elementary threads, contained in a longitudinal slice of the magnet perpendicular to its thickness." The results of his calculations to discover this area led him to conclude that the magnetic threads are less numerous in proportion as one removes from the perimeter of the middle zone, and in proportion as one penetrates into the substance. That was evident *a priori*, but the author argues further that during magnetisation the force of the coil exerts itself directly upon the surface; but, experiment proving that it is not transmitted through a bed of steel of sufficient thickness, we can but admit that its action on a core rapidly diminishes with the depth. Call F the intensity in the exterior points: it will be $\frac{F}{a}$ at a distance 1, $\frac{F}{a^2}$ at a distance 2, and $\frac{F}{a^y}$ at a depth y. Now the quantity of magnetism developed in a slice whose thickness is dy

should be proportional to the force, and consequently equal to $\frac{F\,dy}{a^y}$. The definite integral for a thickness y will be $m = M\left(1 - \frac{1}{a^y}\right)$, and will represent the quantity of magnetism contained herein. These reasonings being very important the experiments were recommenced, and the results were found to be the same as before, with but very trifling exceptions. In conclusion, M. Jamin says—"I think I may conclude from my experiments that there is no magnetisation in the centre of a thick bar of steel; that the elementary threads composed of magnets only commence to appear at a distance of 3 or 4 m.m. from its surface.

No. 19.

The Interior Distribution of Magnetism in a Bundle of several Plates.—M. J. Jamin.—Referring to his previous investigations (see above), he says—"What becomes of these threads and these poles when any number of plates are piled one upon another?" He proceeded to investigate in that direction, and the results of experiments prove that—(1). In proportion as the number of plates increase, the intensities augment at each point. A bundle then possesses, in *quantity* and in *tension*, more magnetism than each of its elements. (2). The total magnetism, M, of the bundle is equal to $m\,n$, the sum of the magnetisms of each of the n elements; that is to say, m, the magnetism of each plate, is constant. (3). From that the conclusion is derived that the bundle is magnetised in all its parts, and therefore it is more energetic than a single core of the same thickness and possessing only a superficial magnetisation. (4). If the number of plates n is small, each plate, when they are all made into a bundle, preserves its own magnetism; if n exceeds a certain number the surfaces are saturated, M reaches a constant limit, and m decreases. (5). The limit of M only depends on the extent of the magnet's surface.

On the Determination of Pure Simple Bodies by the Action of Battery Currents in the Voltameter.—M. E. Martin.—An important paper. It will be published *in extenso.*

Nature, Vol. x., No. 238. May 21, 1874.

Brilliant Meteor.—A correspondent, Mr. Wm. W. Kiddle, writes, under date May 20th, that in the neighbourhood of Holyhead, at 10 minutes to 1 on the night of the 19th *idem*, he witnessed a most brilliant meteor. It formed near Antares, remained stationary for two or three seconds, and then slowly moved to the northward, disappearing in Ursa Major. The form of the meteor was an elongated ellipse, and slightly contracted at one end with the major axis of the apparent diameter of the sun. Shortly before its disappearance six large discharges issued from the southern end with—Mr. Kiddle thought—a crackling sound.

Les Mondes. Vol. xxxiii., No. 17. April 23, 1874.

This number contains no electrical papers.

No. 18. April 30, 1874.

Automatic Controller of the Efficacy of Lightning Conductors.—Reserved for full translation.

On Magnetic Conductibility from a Mechanical Point of View.—M. J. Moutier.—In Ampère's theory, magnets are regarded as formed of a series of equal circular parallel currents set in the same direction. Each of these currents may be considered due to a movement of the ether which takes place with a velocity v proportional to the strength of the current. The free magnetism at any point of the bar depends, then, upon the difference of the strengths of the neighbouring currents. Let us consider the movement which propagates itself in a long bar of soft iron whose extremities are surrounded by two bobbins, and magnetised by currents traversing them. The speed of the ether in each of the particular currents may be considered as a constant fraction of the velocity of the ether in the particular preceding current, so that at the distance x from one of the extremities, the strength of the particular current which corresponds to the bobbin placed at that extremity may be represented by a^{-x}, of which a is a constant. The strength of the particular current which corresponds to the second bobbin is $a^{-(l-x)}$, of which l equals the bar's length. The velocities in the same direction are added, and the strength of the particular current produced by the two bobbins is, at a distance x from the first extremity—

$$v = a^{-x} + a^{-(l-x)}.$$

The strength of the free magnetism at this point is—

$$\frac{dv}{dx} = -\log. a\left\{a^{-x} - a^{-(l-x)}\right\}$$

The magnetic intensities are restrained,—a result conformable to M. Jamin's experiments. When the currents of the two bobbins are in contrary directions, then the velocities of the particular currents are restrained at every point—

$$v = a^{-x} - a^{-(l-x)},$$

$$\frac{dv}{dx} = -\log. a\left\{a^{-x} + a^{-(l-x)}\right\}.$$

showing that the magnetic intensities are added,—a result equally conformable to experience. In the case of a single bobbin placed at *one* of the extremities of a soft short bar of iron, M. Jamin observed a reflection of the magnetism to the opposite end of the bar. The magnetic intensities which correspond to the incident wave, and to the reflected wave, are added, and we must conclude, after what precedes, that the reflection of the magnetic wave to the end of the bar changes the direction of the particular current. In these experiments, the magnetic intensity is measured by the square root of the disruptive force of a small constant mass of soft iron. The magnetic intensity in a point of the bar is measured by $\frac{dv}{dx}$; the magnetism is propagated, when the armature is submitted to disruption, to the point of contact of the magnet with the armature, and the increase of fresh power which results from the presence of this magnetism is $\left(\frac{dv}{dx}\right)^2$.

City and Commercial Notes.

THE telegraph steamer *Faraday*, of Messrs. Siemens Brothers, left Gravesend on the 16th inst., for Nova Scotia, with over 4000 tons of cable, forming the Newfoundland-New Hampshire section of the Direct United States Cable Company.

The French Government, with a view to obtain a reduction of rates for telegrams to the East, has, according to the *Times*, granted a concession to an Anglo-French combination of capitalists for the exclusive right to lay cables between the South Coast of France and the Eastern shores of the Mediterranean, with special privileges for the direct and uninterrupted transmission of messages from England through France to the East. The concession further grants a reduction of one-half of the ordinary rates over the French telegraphic system. With reference to the above Sir James Anderson writes to the *Times* as follows:—

"The Eastern Telegraph Company (Limited),
66, Old Broad Street, May 19.

"Sir,—In your issue of to-day you state that the French Government, with the view to obtain a reduction of rates for telegrams to the East, has granted a concession conferring the exclusive right to lay cables between the South Coast of France and the Eastern shores of the Mediterranean, with special privileges regarding the transmission of English messages and a reduction of the French local rates.

"Your readers are doubtless aware that all matters affecting the international telegraph traffic are regulated by an International Convention, the last of which was held at Rome, in December, 1871, and at which the French Government was of course represented. The tariff for messages to the East was fixed by the Convention.

"I was one of the representatives of the Eastern Company, and never heard any expression of opinion on the part of the representative of the French Government that the tariff was fixed higher than required to give a fair return on the cost of the cables.

"As to the alleged exclusive right, I need only state the fact that the Eastern Company has had for some years at work a cable from Marseilles to Algiers, Malta, and Egypt. Messages over this cable for Egypt are sent through without transmission at Algiers.

"The special privileges for the transmission of messages from England, *via* Marseilles, to be enjoyed by the projected new company cannot possibly be greater than those at the command of the Eastern Company under an agreement lately concluded with Her Majesty's Postmaster-General and the Submarine Telegraph Company, which places a special wire in its cables to Calais at the disposal of the Eastern Company, while the French telegraph authorities have declared their readiness to grant a special wire in continuation from Calais to Marseilles.

My Company possesses actually a direct line *via* Falmouth to the East, and another *via* Marseilles, a third *via* Italy and Candia, and still another in connection with the Mediterranean Extension Company, *via* Italy and Malta.

"We have thus four distinct routes from Europe to Egypt without work enough for half of them; and I have no hesitation in expressing my conviction that no single line can ever successfully compete against such a system.

"I am somewhat curious to see on what grounds the English public will be asked, under such circumstances, to spend several hundred thousand pounds for no other purpose than to add another cable to the many which already lie insufficiently employed at the bottom of the Mediterranean.

"I am, Sir, yours truly, JAMES ANDERSON."

A prospectus has been issued of the Black Sea Telegraph Company (Limited), with a capital of £130,000, in shares of £10, of which 10,000 shares are for subscription. The company have acquired exclusive concessions for thirty years from the Emperor of Russia and the Sultan of Turkey, for establishing a submarine telegraph between Odessa and Constantinople, which, besides affording telegraphic facilities for the trade of the Black Sea and Sea of Azov, will, by means of the system of the Eastern Telegraph Company, which now extends to Constantinople, complete a telegraph route to foreign countries for every portion of Russia. The Telegraph Construction Company have contracted to lay the cable early next month for £97,000 in cash and £30,000 in fully paid shares. The President of the Great Northern Telegraph Company is chairman.

At an extraordinary meeting, held on the 30th ult., the West India and Panama Telegraph Company, Limited proposed a creation of £1,100,000 further capital to acquire the concessions, cables, and property of the Central American Telegraph Company, so as to connect the States of South America by the company's lines and connexions with the West Indies and with North America, and to complete the duplication of the company's system between Jamaica and Trinidad, &c. It is intended to issue £900,000 of the amount in fully paid shares, in payment for such concessions, cables, and property, and £100,000 in 10,000 Ten per Cent Second Preference Shares of £10 each.

A dividend of 7½ per cent was declared on the 20th inst. at the meeting of Reuter's Telegram Company, Limited, making, with the interim dividend of 2½ per cent paid in October, a total distribution for the year of 10 per cent. The balance which remains after the payment of the dividend is appropriated as follows, namely, £1,000 to the reserve fund, £500 written off the lease account, and a balance of £244 17s. 5d. carried forward to next account.

TELEGRAPH SHARE LIST.

Amount per Share.	NAME OF COMPANY.	Amount paid up.	Closing Quotations.
£		£	May 29.
Stock	Anglo-American (Limited)	100	69½—70
10	Brazilian Submarine..	All	7¼—7½
10	Cuba	All	7¼—7¾
10	Direct Spanish	9	..—..
20	Direct United States Cable	All	14—15
10	Eastern (Limited)	All	7¼—7½
..	Do., New	..	102—104
10	Eastern Extn. Australia and China	All	7⅜—7⅝
10	Globe Telegraph and Trust	All	6¼—6½
10	Do., 6 per cent Pref...	All	9⅜—9⅝
10	Great Northern	All	10—10½
25	Indo-European	All	15½—16½
10	Mediterranean Extension (Limited)	All	4—4½
10	Do., 8 per cent Pref...	All	11—12
10	Panama and South Pacific	2½	..—.. dis.
8	Reuter's..	All	10½—11
Stock	Submarine	100	220—225
1	Do., Scrip	All	2—2¼
10	West India and Panama	All	4¼—4¾
10	Do., 10 per cent Pref.	All	10¼—10¾
20	Western and Brazilian (Limited) ..	All	11—11½
1000 dls.	West Un. U.S. 7 per cent 1st M.B.	All	102—105
10	Hooper's Telegraph Works	All	12—13
50	India-Rubber and Gutta Percha ..	All	21—23
Cert.	Submarine Cables Trust	100	105—108
12	Telegraph Construction	All	30¼—30¾
100	Ditto Ditto 7 per cent Bonds	All	103—105

Patents.

2629. Josiah Latimer Clarke, of 5, Westminster Chambers, Victoria Street, Westminster, civil engineer. *Improvements in Apparatus for Recording the Number of Passengers Conveyed in Public Vehicles, and the Distance each has Travelled.* Dated August 5, 1873.—The apparatus described in this provisional specification is electric, and by it marks are produced upon chemically prepared paper.

2656. W. R. Lake, of Haseltine, Lake, and Co., London. (A communication from F. L. Pope, of Elizabeth, New Jersey, electrical engineer). *Improvements in Railway Signal Apparatus.* Dated August 7, 1873.—This invention relates to certain improvements in appliances for operating semaphoric and audible signals in railways, or causing them to be operated, by the agency of electricity, and to the construction of the said signals.

2710. L. Hill, of Glasgow, civil engineer. *Improvements in Speed-Regulating Apparatus for Marine Engines.* Dated August 15, 1873.—The invention consists in arranging an electro-magnet to act on the lever of the throttle or regulator valve, either directly or as is preferred through the intervention of a frictional clutch moved by the engine, the electro-magnet being made to act by the closing of an electric circuit on the propeller becoming too little immersed in the water.

2870. J. B. Stearns, of Boston, Massachusetts, U.S., electrician. *Improvements in Electric Telegraph Apparatus.* Dated September 1, 1873.—The said invention relates to various improvements in electric telegraph apparatus. I so connect a condenser to the branch circuit that any desired proportion of the charge will return through the receiving instrument. I place resistance coils between the said receiving instrument and the line or cable, and between the said instrument and condenser, and in other parts of the apparatus; and I also place an artificial escape between the said instrument and the line or cable. In working long lines with the duplex system, I use a reversing key and polarised relay in combination with the line or cable and other parts of the apparatus forming the so-called "Wheatstone bridge." In long lines I employ a second line, according to the method called looping, and with the duplex apparatus I use switches, whereby the apparatus is adjusted, either for loop working or ordinary working.

2988. T. A. Edison, of Newark, New Jersey, U.S. *Improvements in Perforated Paper for Telegraphic Purposes, and in Means for Receiving and Transmitting with the Same.* Dated September 11, 1873.—The paper used for transmitting is perforated in groups representing ordinary Roman or block letters. The machine for perforating is similar to that in Patent No. 1751, A.D. 1872, except that the punches are massed in a square of five each way, and perforate the letter like that on the finger key. The transmitting is effected by as many line wires and styluses as there are rows of punches, and the message is marked on the chemical paper in letters or characters like printing, the dots being contiguous. Rollers and spring stylus fingers drawing across the strip of paper are to be used at the transmitting and receiving station when only a single wire is used.

2956. L. Fréret, of London. (A communication from H. Guerot, of Paris, and O. Lesourd, of Livry (Seine et Oise). *An Improved Electric Battery.* Dated September 9, 1873.—The features of novelty of this invention consist—First, in partly enamelling or varnishing the porous cell; and secondly, in charging the battery with a mixture composed of bichromate of potash, sulphate of iron, sulphate of soda, and monohydrate sulphuric acid in certain proportions.

2976. W. B. Brain, of Gloucester, mining engineer. *Improved Construction of Electric Fuzes for Discharging Dynamite Lithofracteur and other Blasting Bodies or Compounds.* Dated September 10, 1873.—This consists in enclosing within a paper or other tube on the end of the conducting wires a composition which becomes incandescent under the action of an electric current, and thereby communicates the heat or spark to the charge.

2969. W. Moseley, of Manchester, electrical engineer. *Improvements in Electrical-Signal Apparatus.* Dated September 10, 1873.—My invention relates to the novel construction and attachment of the various portions of electrical apparatus used for the transmission of signals on board ships and in hotels and other buildings, and for similar purposes. Such apparatus differs from the long lines and instruments used for public telegraphic purposes chiefly in this respect, namely, that in the latter the battery is always near the commutators and a short portion of wire leads from the negative pole of the battery to the commutators, but in the aforesaid electrical apparatus the battery cannot be near all the commutators,—hence the great importance of securing good insulation; and my object is the construction of the principal portions of the apparatus and the combination of its parts in such a manner as will exclude the various sources of irregularity and other difficulties which have heretofore been found inseparable from such apparatus.

3078. S. J. Moore, of London, and R. H. Courtenay, of Surrey. *An Improved Compound Motive Power Electro-Magnet.* Dated September 19, 1873.—The novelty of the invention consists in constructing a magnet of movable and fixed parts, which, when arranged to act in unison with a similar magnet, or a series of magnets deriving their magnetic force from a commutator, will transmit a power for driving machinery or propelling ships.

3083. A. Wilkinson, of Middlesex, engineer. *Improvements in Coating and Preserving Telegraph Wires, Ropes, and Cables.* Dated September 19, 1873. This consists, first, in coating the fabric-covered wire with a solution of white lead, pitch, boiled or raw linseed oil, tallow, and naphtha; secondly, in coating the threads or strips of fabric to cover the wires by passing them through a bath containing white lead, pitch, and boiled and raw linseed oil; thirdly, in first coating threads in a solution of white lead, pitch, or its equivalent, until they become dry, these threads being then wrapped on to the bare wires, which are afterwards further coated by lead or other metal.

3290. G. Haseltine, of London, Doctor of Laws. (A communication from T. S. Hall, of West Meriden, Connecticut, and A. L. Van Blarcom, of Summit, New Jersey, U.S. *Improvements in Electro-Magnetic Railway Signal-Apparatus.* Dated October 10, 1873.—This invention consists in a series of signal-houses arranged in combination with line wires which connect with electro-magnets in the signal-houses and with track instruments: one battery serves to vitalise the electro-magnets whenever the wheels of a passing train act on the corresponding track instruments; also in the combination of signals of safety with signals of danger arranged on the line of a railway in pairs, said signals being operated alternately by electro-magnetism and by gravitation; further, in the arrangement of a locking lever in combination with each signal; also in the combination of a piston with the key lever of a circuit-closing instrument and with a track lever in such a manner that when the piston is forced upwards to operate the key lever an air-cushion is formed in the cylinder, which prevents the piston from being slammed against the cylinder head.

It is stated that in consequence of the great success of the duplex system of telegraphing, by which messages are transmitted through a wire in opposite directions at the same time, and by which a considerable reduction has been made in the manual labour of working, the Post Office contemplates the immediate reduction of existing charges in a ratio of about 50 per cent, and are making inquiries with the view of carrying the object into effect. The difficulty of obtaining increased office space for additional intstruments and additional clerical assistance, certain to be required, seems the only obstacle at present to be considered.—*Court Journal.*

Telegraphic Wire.—The increase in the exportation of telegraphic wire and apparatus was remarkable in the last four months compared with the preceding year. The sums were respectively £429,643 and £122,099.

To Correspondents.

*** Duly authenticated contributions, theoretical and practical, on every subject identified with the interests of which "The Telegraphic Journal" is the organ, will always command attention. Anonymous correspondence will be wholly disregarded. Literary communications and books for review should be addressed to the Editor; business communications to the Publisher.

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